

### Abstract

Versions of the invention are directed to methods (and related techniques) for a new type of association based linkage study technique using bi-allelic markers. The markers used in versions of the new linkage studies are chosen using a new two-dimensional concept of "closeness" in terms of marker distribution over a two-dimensional region having the orthogonal dimensions of chromosomal location and least common allele frequency. By using the two characteristics or two dimensions of marker chromosomal location and marker allele population frequency in this unique way, the power and systematic nature of genetic linkage studies using association based linkage tests is greatly increased. These unique two-dimensional linkage study techniques increase the power of association based linkage studies to localize trait causing genes or polymorphisms of modest effect such as human disease causing polymorphisms.